CURRICULUM VITAE (updated May 2015)

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CONTACT INFORMATION

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EDUCATION

Ph.D. Geochemistry (1991) Colorado School of Mines, Golden, CO
Factors influencing metal sorption onto iron-rich sediment in acid-mine drainage: Ph.D. dissertation T-3925, 239 p. (***14 Google Scholar citations***)

M.S. Geochemistry (1986) Colorado School of Mines, Golden, CO
Adsorption of copper and lead onto goethite as a function of pH, ionic strength, and metal and total carbonate concentrations: M.S. thesis T-3057, 177 p.

B.S. Environmental Geology (1978) Beloit College, Beloit, WI
Senior thesis: *Lead in the environment* NSF Undergraduate Research Grant: *A comparative study of Turtle Creek, Little Turtle Creek and Spring Brook with regard to sediment characteristics, Rock and Walworth Counties, Wisconsin*.

SELECTED PROFESSIONAL EXPERIENCE

1979–present: Geologist/Research Geologist, U.S. Geological Survey, Denver, CO

Project Management and Supervisory: Responsible for project or task coordination, budgets and direct supervision of 1-7 scientists.

- **Task Chief,** *Metal and Mineral Commodities in Waste Streams*, (2013-present), to investigate metal-recovery potential of valuable and critical commodities present in diverse waste streams (including mine waters, historical mining wastes and municipal biosolids).
- **Project Chief/Task Chief**, *Integrated Methods Development Project* ($1.5 million; 2008-2012), an interdisciplinary project to develop tools and conduct research requiring integration of geologic, geophysical, geochemical, and remote-sensing expertise.
- **Task Chief**, *Development of Mineral Environmental Assessment Techniques at the Watershed Scale Task* (2008-2012), to develop integrated hydrologic, geologic, geochemical, ecological, and toxicological watershed characterization and modeling methodologies.
- **Project Chief/Task Chief,** *Aqueous Geochemistry Research and Development Project* (2001-2007), to develop and test new and emerging scientific methods and modeling applications, and investigate promising research topics in the field of aqueous geochemistry applied to the environmental geochemistry of mineralized areas.
- **Associate Project Chief/Task Chief**, *Process Studies of Contaminants Associated with Mineral Deposits Project* (2001-2007), Task examined processes to understand the (1) ability of mine waste to generate acid, (2) source(s) and sink(s) of possible metal and metalloid contaminants in the mine

waste, (3) processes controlling metal and acid release into the environment, (4) possible metal-transport mechanisms, and (5) bioaccessibility of the released metals.

Project Chief, *Mine Waste Characterization Project* (1996-2000), project of about 30 scientists adopted a multidisciplinary approach to assemble, develop and refine methods and tools for characterizing and screening weathered mine-waste materials for the assessment of metal mobility, acid-drainage production and potential toxic effects.

Geologic Division, *Activities Funded by the Toxic Substances Hydrology Program* (1996-2012), participated in geochemical studies at hardrock mining sites.

SELECTED RESEARCH ACTIVITIES

General Research Interests: low-temperature aqueous geochemistry, environmental geochemistry, water/rock interactions, trace-element geochemistry, metal bioavailability, environmental toxicology of metals, characterization of mining wastes, leaching techniques, and sampling methodologies.

Mining Waste Characterization and Geoavailability Studies: performed mineral-environmental studies dealing with metal mobility and geoavailability. In the study of the potential impact of mining sites it is important to understand the (1) ability of mine waste to generate acid, (2) source(s) and sink(s) of possible metal and metalloid contaminants in the mine waste, (3) processes controlling metal and acid release into the environment, (4) possible metal-transport mechanisms, and (5) bioaccessibility of the released metals. Joined with researchers from a variety of disciplines, including geophysics, geochemistry, analytical chemistry, geology, mineralogy, geomicrobiology, and remote sensing, to develop an integrated "toolkit" for the screening and characterization of historical mining waste piles. Tools developed from our work are being used by consultants, land managers and regulators in ranking and prioritizing historical mine-waste piles for remediation or further study.

Mine-Drainage Characterization and Metal Sorption and Mobility Studies: conducted studies of diverse mine-drainage waters, in collaboration with Geoff Plumlee and Walt Ficklin, that provided a foundation for developing geoenvironmental mineral-deposit models (GEMs). In metal-sorption and metal-mobility work, adapted computer models developed for laboratory sorption studies and successfully applied them to natural field situations, which expanded the ability to predict metal mobility from mined sites. In metal-mobility studies, developed some chemically based general concepts that can be used to anticipate metal mobility and metal bioavailability.

Use of Biotic Ligand Models to Predict Metal Toxicity to Aquatic Biota: investigated application of biotic ligand models (BLMs) to mineral-environmental studies to (1) provide a connection between geoenvironmental models and aquatic toxicity predictions, (2) evaluate the use of BLMs to predict toxic effects of metals in areas underlain by different rock types and in mined and mineralized areas, and (3) establish what modifications need to be made for the regulatory use of BLMs in mined and mineralized areas. BLMs employ a computational approach to predict chemical speciation and acute toxicological effects of metals on aquatic biota. In 2007 the US EPA incorporated a BLM into their regulatory water-quality criteria for copper.

Effects of Fluvial Tailings Deposits on Water Quality in the Upper Arkansas River Basin, Colorado: integrated research project with Katie Walton-Day and Jim Ranville (Colorado School of Mines) to evaluate effects of a fluvial tailings deposit on water quality along a reach of the upper Arkansas River south of Leadville, Colorado. The upper Arkansas River has been the focus of a great deal of research on water-quality related impacts on the environment from past and current mining practices. Although treatment plants designed to remove metals have improved conditions for brown trout (the dominant species), episodic events and nonpoint sources of pollution are still of concern. Fluvial tailings deposits along the river represent potential nonpoint sources of metals and acidity.

Sampling and Monitoring for the Mine Life Cycle: collaborated with Virginia McLemore (New Mexico Bureau of Geology and Mineral Resources) and Carol Russell (US EPA) on several publications and a recently published handbook on mining related environmental sampling and

monitoring. Our approach emphasizes the importance of designing sampling and monitoring programs to account for all aspects of the mine life cycle, from exploration, through feasibility studies, into mine planning, actual mining, reclamation, and closure. We demonstrate the importance of anticipating and incorporating data needs that will be required during the later stages of the mine life cycle. Our approach has generated interest from consultants, regulators and the mining industry.

Metal Recovery from Waste Streams: apply geochemical skills to resource and commodity life cycles. 'Waste streams' is a general term to describe the total flow of waste from homes, businesses, industrial facilities, and institutions that are recycled, burned or isolated from the environment in landfills or other types of storage, or dissipated into the environment. Waste streams can contain a variety of chemical elements, including valuable and critical mineral commodities, that may represent untapped resources for metal recovery and reuse.

SELECTED OUTREACH ACTIVITIES

Author/co-author of over 100 technical presentations and over 100 publications.

Presenter/Organizer/Committee Member of 16 short courses/workshops/field trips, 4 international conferences, and numerous technical sessions.

Steering Committee, Acid Drainage Technology Initiative-Metal Mining Sector (2003-present).

Research Professor, Department of Chemistry and Geochemistry, Colorado School of Mines (2006-2009); served on 7 thesis committees.

CLU-IN webinar presentation (invited) for series on hardrock mining geochemistry and hydrology; *Sampling considerations at mining sites*, www.clu-in.org/conf/tio/r10hardrock3_030513/.

American Chemical Society Press Conference (YouTube), Sewage—yes, poop—could be a source of valuable metals and critical elements, streamed live 3/24/2015, www.youtube.com/watch?v=tTkz_dTgGAc&list=PLLG7h7fPoH8LtUyqg-vxxZO3GlujdfXh6&index=13.

SELECTED PUBLICATIONS (reverse chronological order)

Smith, K.S., Phillips, J.D., McCafferty, A.E., and Clark, R.N. (eds.), *in press*, Developing integrated methods to address complex resource and environmental issues: U.S. Geological Survey Circular.

Smith, K.S., Balistrieri, L.S., and Todd, A.S., 2015, Using biotic ligand models to predict metal toxicity in mineralized systems (review paper): Applied Geochemistry, v. 57, p. 55-72, http://dx.doi.org/10.1016/j.apgeochem.2014.07.005. (***2 Google Scholar citations***)

Smith, K.S., Hageman, P.L., Plumlee, G.S., Budahn, J.R., and Bleiwas, D.I., 2015, Potential metal recovery from waste streams, *in* Proceedings, International Applied Geochemistry Symposium, Tucson, AZ, 8 p.

McLemore, V.T., Smith, K.S., and Russell, C.C., (eds.), 2014, Sampling and monitoring for the mine life cycle, Management Technologies for Metal Mining Influenced Water Series, v. 6: Englewood, CO, Society for Mining, Metallurgy, and Exploration, Inc., 191 p. (plus 6 digital appendices), www.smenet.org/store/mining-books.cfm/Sampling-%26-Monitoring-for-the-Mine-Life-Cycle/355-7 (author/co-author of 7 chapters, 2 sidebars and 16 method summaries). (***1 Google Scholar citation***)

Smith, K.S., McLemore, V.T., and Russell C.C., 2014, Sampling considerations in the mining environment, Chapter 3, *in* V.T. McLemore, K.S. Smith, and C.C. Russell (eds.), Sampling and Monitoring for the Mine Life Cycle, Management Technologies for Metal Mining Influenced Water Series, v. 6: Englewood, CO: Society for Mining, Metallurgy, and Exploration, Inc., p. 33-109. (***1 Google Scholar citation***)

Smith, K.S., Ranville, J.F., Lesher, E.K., Diedrich, D.J., McKnight, D.M., and Sofield, R.M., 2014, Fractionation of fulvic acid by iron and aluminum oxides—Influence on copper toxicity to *Ceriodaphnia dubia*: Environmental Science and Technology, v. 48 (20), p. 11934–11943, http://dx.doi.org/10.1021/es502243m.

Hoal, K.O., Woodhead, J., and Smith, K.S., 2013, The importance of mineralogical input into geometallurgy programs, *in* Proceedings, Second AusIMM International Geometallurgy Conference (GeoMet 2013), Brisbane, Qld, Australia, p. 17-25 (keynote paper).

Smith, K.S., Figueroa, L.A., and Plumlee, G.S., 2013, Can treatment and disposal costs be reduced through metal recovery? *in* A. Brown, L. Figueroa, and C. Wolkersdorfer (eds.), Reliable Mine Water Technology, International Mine Water Association (Vol. I): Denver, CO, Publication Printers, p. 729-735, http://imwa.info/docs/imwa_2013/IMWA2013_Smith_470.pdf. (***2 Google Scholar citations***)

Smith, K.S., Hoal, K.O., Walton-Day, K., Stammer, J.G., and Pietersen, K., 2013, Automated quantitative micro-mineralogical characterization for environmental applications, *in* Proceedings, 2013 Society for Mining, Metallurgy and Exploration (SME) Annual Meeting and Exhibit, Preprint 13-140, 7 p. (***1 Google Scholar citation***)

Yager, D.B., Johnson, R.H., Rockwell, B.W., Caine, J.S., and Smith, K.S., 2013, A GIS and statistical approach to identify variables that control water quality in hydrothermally altered and mineralized watersheds, Silverton, Colorado, USA: Environmental Earth Sciences, v. 70, p. 1057-1082, http://dx.doi.org/10.1007/s12665-013-2229-y. (***2 Google Scholar citations***)

Smith, K.S., Walton-Day, K., Hoal, K.O., Driscoll, R.L., and Pietersen, K., 2012, Pre- and post-remediation characterization of acid-generating fluvial tailings material, *in* Proceedings, 9th International Conference on Acid Rock Drainage (ICARD9), Ottawa, Ontario, Canada, 10 p., http://minerals.usgs.gov/east/mea/ICARD2012_Smith.pdf. (***1 Google Scholar citation***)

Smith, K.S., 2011, Approach for environmental baseline water sampling, *in* Proceedings, Society for Mining, Metallurgy, and Exploration (SME) Annual Meeting and Exhibit, Denver, Colorado, Preprint 11-157, 6 p. (***1 Google Scholar citation***)

Desborough, G.A., Smith, K.S., Lowers, H.A., Swayze, G.A., Hammarstrom, J.M., Diehl, S.F., Leinz, R.W., and Driscoll, R.L., 2010, Mineralogical and chemical characteristics of some natural jarosites: Geochimica et Cosmochimica Acta, v. 74, p. 1041-1056, http://dx.doi.org/10.1016/j.gca.2009.11.006. (***31 Google Scholar citations***)

Custer, C.M., Yang, C., Crock, J.G., Shearn-Bochsler, V., Smith, K.S., and Hageman, P.L., 2009, Exposure of insects and insectivorous birds to metals and other elements from abandoned mine tailings in three Summit County drainages, Colorado: Environmental Monitoring and Assessment, v. 153, p. 161-177, http://dx.doi.org/10.1007/s10661-008-0346-y. (***13 Google Scholar citations***)

McLemore, V.T., Russell, C.C., and Smith, K.S., 2009, ADTI-MMS sampling and monitoring for the mine-life cycle, *in* Proceedings, Securing the Future and Eighth International Conference on Acid Rock Drainage (ICARD8), Skellefteå, Sweden, June 22-26, 2009, 10 p., www.proceedings-stfandicard-2009.com/pdfer/Virginia_McLemore_B4_T3_ADTI-MMS-Sampling-and-Monitoring-for-the-Mine-life-Cycle.pdf.

Smith, K.S., Ranville, J.F., Diedrich, D.J., McKnight, D.M., and Sofield, R.M., 2009, Consideration of iron-organic matter interactions when predicting aquatic toxicity of copper in mineralized areas, *in* Proceedings, Securing the Future and Eighth International Conference on Acid Rock Drainage (ICARD8), Skellefteå, Sweden, June 22-26, 2009, 9 p., www.proceedings-stfandicard-2009.com/pdfer/Kathleen_Smith_B5_T6_Consideration-of-Iron-Organic-Matter-Interactions-when-Predicting-Aquatic-Toxicity-of-Copper-in-Mineralized-Areas.pdf. (***5 Google Scholar citations***)

McLemore, V.T., Smith, K.S., Russell, C.C., and the Sampling and Monitoring Committee of the Acid Drainage Technology Initiative-Metal Mining Sector (ADTI-MMS), 2007, Sampling and monitoring for closure, Chapter 11, *in* DeGraff, J.V., (ed.), Reviews in Engineering Geology, v. 17, Understanding and Responding to Hazardous Substances at Mine Sites in the Western United States: Geological Society of America, p. 171-180, http://dx.doi.org/10.1130/2007.4017(11). (***1 Google Scholar citation***)

Smith, K.S., 2007, Strategies to predict metal mobility in surficial mining environments, Chapter 3, *in* DeGraff, J.V., (ed.), Reviews in Engineering Geology, v. 17, Understanding and Responding to Hazardous Substances at Mine Sites in the Western United States: Geological Society of America, p. 25-45, http://dx.doi.org/10.1130/2007.4017(03); www.clu-in.org/conf/tio/r10hardrock3_030513/resource.cfm. (***24 Google Scholar citations***)

Smith, K.S., Hageman, P.L., Briggs, P.H., Sutley, S.J., McCleskey, R.B., Livo, K.E., Verplanck, P.L., Adams, M.G., and Gemery-Hill, P.A., 2007, Questa baseline and pre-mining ground-water quality investigation: 19. Leaching characteristics of composited materials from mine waste-rock piles and naturally altered areas near Questa, New Mexico: U.S. Geological Survey Scientific Investigations Report 2006-5165, 49 p., http://pubs.usgs.gov/sir/2006/5165/.

Wildeman, T.R., Smith, K.S., and Ranville, J.F., 2007, A simple scheme to determine potential aquatic metal toxicity from mining wastes: Environmental Forensics Journal, v. 8, p. 119-128, http://dx.doi.org/10.1080/15275920601180651. (***2 Google Scholar citations***)

Diehl, S.F., Hageman, P.L., and Smith, K.S., 2006, What's weathering? Mineralogy and field leach studies in mine waste, Leadville and Montezuma mining districts, Colorado, *in* Proceedings, Seventh International Conference on Acid Rock Drainage (ICARD 7), St. Louis, Missouri, March 26-30, 2006, p. 507-527, http://www.imwa.info/docs/imwa_2006/0507-Diehl-CO.pdf. (***8 Google Scholar citations***)

Ranville, J., Blumenstein, E., Adams, M., Choate, L., Smith, K., and Wildeman, T., 2006, Integrating bioavailability approaches into waste rock evaluations, *in* Proceedings, Seventh International Conference on Acid Rock Drainage (ICARD 7), St. Louis, Missouri, March 26-30, 2006, p. 1642-1653, http://www.imwa.info/docs/imwa_2006/1642-Ranville-CO.pdf. (***5 Google Scholar citations***)

Smith, K.S., Ranville, J.F., Adams, M.K., Choate, L.M., Church, S.E., Fey, D.L., Wanty, R.B., and Crock, J.G., 2006, Predicting toxic effects of copper on aquatic biota in mineralized areas by using the biotic ligand model, *in* Proceedings, Seventh International Conference on Acid Rock Drainage (ICARD 7), St. Louis, Missouri, March 26-30, 2006, p. 2055-2077, http://www.imwa.info/docs/imwa_2006/2055-Smith-CO.pdf. (***9 Google Scholar citations***)

Smith, K.S., 2005, Acid rock drainage, *in* Price, L.G., Bland, D., McLemore, V.T., and Barker, J.M., eds., Mining in New Mexico—The Environment, Water, Economics, and Sustainable Development, Decision-Makers Field Guide 2005, Chapter 2: New Mexico Bureau of Geology and Mineral Resources, p. 59-63, http://geoinfo.nmt.edu/publications/guides/decisionmakers/2005/. (***3 Google Scholar citations***)

Smith, K.S., 2005, Use of the biotic ligand model to predict metal toxicity to aquatic biota in areas of differing geology, *in* Proceedings, 2005 National Meeting of the American Society of Mining and Reclamation, Breckenridge, Colorado, June 19-23, 2005, p. 1134-1154, www.researchgate.net/profile/Kathleen_Smith3/publication/228513621_Use_of_the_Biotic_Ligand_Model_to_predict_metal_toxicity_to_aquatic_biota_in_areas_of_differing_geology/links/09e4150f739f91ebc4000000.pdf. (***4 Google Scholar citations***)

Smith, K.S., Wildeman, T.R., Choate, L.M., Diehl, S.F., Fey, D.L., Hageman, P.L., Ranville, J.F., Rojas, R., and Smith, B.D., 2003, Determining the toxicity potential of mine-waste piles: U.S. Geological Survey Open-File Report 03-210, http://pubs.usgs.gov/of/2003/ofr-03-210/. (***2 Google Scholar citations***)

Hammarstrom, J.M., and Smith, K.S., 2002, Geochemical and mineralogic characterization of solids and their effects on waters in metal-mining environments, *in* Seal, R.R., II, and Foley, N.K., eds., Progress on Geoenvironmental Models for Selected Mineral Deposit Types: U.S. Geological Survey Open-File Report 02-0195, p. 8-54, http://pubs.usgs.gov/of/2002/of02-195/. (***17 Google Scholar citations***)

Smith, K.S., Campbell, D.L., Desborough, G.A., Hageman, P.L., Leinz, R.W., Stanton, M.R., Sutley, S.J., Swayze, G.A., and Yager, D.B., 2002, Toolkit for the rapid screening and characterization of waste piles on abandoned mine lands, *in* Seal, R.R., II, and Foley, N.K., eds., Progress on Geoenvironmental Models for Selected Mineral Deposit Types: U.S. Geological Survey Open-File Report 02-0195, p. 55-64, http://pubs.usgs.gov/of/2002/of02-195/. (***13 Google Scholar citations***)

Smith, K.S., Ramsey, C.A., and Hageman, P.L., 2000, Sampling strategy for the rapid screening of mine-waste dumps on abandoned mine lands, *in* Proceedings, Fifth International Conference on Acid Rock Drainage (ICARD 2000), Denver, Colorado, May 21-24, 2000, Volume II: Littleton, Colorado, Society for Mining, Metallurgy, and Exploration, Inc., p. 1453-1461, http://crustal.cr.usgs.gov/projects/minewaste/pdfs/kathy.pdf. (***53 Google Scholar citations***)

Swayze, G.A., Smith, K.S., Clark, R.N., Sutley, S.J., Pearson, R.M., Vance, J.S., Hageman, P.L., Briggs, P.H., Meier, A.L., Singleton, M.J., and Roth, S., 2000, Using imaging spectroscopy to map acidic mine waste: Environmental Science and Technology, v. 34, p. 47-54, http://dx.doi.org/10.1021/es990046w. (***200 Google Scholar citations***)

Plumlee, G.S., Smith, K.S., Montour, M.R., Ficklin, W.H., and Mosier, E.L., 1999, Geologic controls on the composition of natural waters and mine waters draining diverse mineral-deposit types, Chapter 19, *in* Filipek, L.H., and Plumlee, G.S., eds., The environmental geochemistry of mineral deposits, Part B: Case studies and research topics, Reviews in Economic Geology, Vol. 6B: Littleton, Colorado, Society of Economic Geologists, Inc., p. 373-432. (***160 Google Scholar citations***)

Smith, K.S., 1999, Metal sorption on mineral surfaces: an overview with examples relating to mineral deposits, Chapter 7, *in* Plumlee, G.S., and Logsdon, M.J., eds., The environmental geochemistry of mineral deposits, Part A: Processes, techniques, and health issues, Reviews in Economic Geology, Vol. 6A: Littleton, Colorado, Society of Economic Geologists, Inc., p. 161-182. (***139 Google Scholar citations***)

Smith, K.S., and Huyck, H.L.O., 1999, An overview of the abundance, relative mobility, bioavailability, and human toxicity of metals, Chapter 2, *in* Plumlee, G.S., and Logsdon, M.J., eds., The environmental geochemistry of mineral deposits, Part A: Processes, techniques, and health issues, Reviews in Economic Geology, Vol. 6A: Littleton, Colorado, Society of Economic Geologists, Inc., p. 29-70. (***155 Google Scholar citations***)

Smith, K.S., Ranville, J.F., Plumlee, G.S., and Macalady, D.L., 1998, Predictive double-layer modeling of metal sorption in mine-drainage systems, Chapter 24, *in* Jenne, E.A., ed., Adsorption of metals by geomedia--variables, mechanisms, and model applications: San Diego, California, Academic Press, p. 521-547. (***33 Google Scholar citations***)

SELECTED RECENT ABSTRACTS OR PRESENTATIONS

Smith, K.S., Hageman, P.L., Plumlee, G.S., Crock, J.G., Yager, T.J.B., Brobst, R.B., and Gebhard, S.C., 2015, Metal occurrence in and potential recovery from municipal biosolids [abstr.]: 249th American Chemical Society National Meeting and Exposition, Denver, CO, March 22-26, 2015, ENVR 95, https://acswebcontent.acs.org/denver2015program/, (accompanying press release at www.acs.org/content/acs/en/pressroom/newsreleases/2015/march/sewage-yes-poop-could-be-a-source-of-valuable-metals-and-critical-elements.html that resulted in extensive national and international media attention).

Smith, K.S., Hageman, P.L., Plumlee, G.S., Budahn, J.R., and Bleiwas, D.I., 2015, Potential metal recovery from waste streams: International Applied Geochemistry Symposium, Tucson, AZ, April 20-24, 2015 (keynote presentation), www.27iags.com/about/symposium-details/key-note/.

Nordstrom, D.K., and Smith, K.S., 2014, Extraction of useful resources from mining-influenced water (MIW) [abstr.], *in* Proceedings, U.S. EPA National Conference on Mining-Influenced Waters, August 12-14, 2014, Albuquerque, NM, p. 69-70.

Plumlee, G.S., Smith, K.S., Hageman, P.L., Hoefen, T.M., Swayze, G.A., Benzel, W.M., Lowers, H.A., Morman, S.A., Wolf, R.E., and Koenig, A.E., 2013, Trace metals and minerals in materials of the built environment: Implications for recycling, disposal, and environmental health [abstr.]: Geological Society of America, Abstracts with Programs, v. 45, no. 7, p.666, https://gsa.confex.com/gsa/2013AM/webprogram/Paper232514.html.

Smith, K.S., Hageman, P.L., Koenig, A.E., Crock, J.G., Yager, T.J.B., and Plumlee, G.S., 2013, Metal recovery from waste streams [abstr.]: Geological Society of America, Abstracts with Programs, v. 45, no. 7, p.721, https://gsa.confex.com/gsa/2013AM/webprogram/Paper226717.html (with attached presentation).

Smith, K.S., Yager, T.J.B., Crock, J.G., Hageman, P.L., and Plumlee, G.S., 2013, Potentially recoverable metals of economic importance in biosolids: Rocky Mountain Water Environment Association (RMWEA) Biosolids Committee Annual Workshop, Fort Collins, Colorado, November 14, 2013 (invited), www.rmwea.org/tech_papers/biosolids/2013_worskshop/RMWEABiosolids2013_Smith_fnl.pdf.